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ABSTRACT

Two instructional design alternatives are described and discussed: (1) the supplantation model of Ausburn and Ausburn (1978), where learning strategies are built into the instructional materials; and (2) a generative design model, where strategies are "built" into the learner. These contrasting models are proposed as representing the extremes of a continuum that illustrates the ratio of the amount of processing support provided by the instruction to the amount of cognitive elaboration required of the learner. The relative advantages and disadvantages of each model are examined, and a line of research is suggested for investigating the conditions under which each model, or compromiser between the two models, might be appropriate. This discussion is related to current philosophical questions in the field of instructional design. Examples are used from the design of instructional print. Twenty-six references are listed. (LMM)

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SUPPLANTATION VERSUS GENERATIVE MODELS:

IMPLICATIONS FOR DESIGNERS OF INSTRUCTIONAL TEXT

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SUPPLANTATION MODEL VERSUS GENERATIVE MODEL: IMPLICATIONS FOR DESIGNERS OF INSTRUCTIONAL TEXT

During the 1984 AERA conference in New Orleans, I attended a session ("Learner Aspects of Human Thinking") in which participants addressed the potential of training students to use metacognitive strategies. Some of the ideas expressed during that session suggest a line of contemplation and research that I want to briefly discuss with you today. This line of inquiry seems to be of particular value because it rather epitomizes the point to which the field of instructional technology appears to have evolved.

The presenters in the AERA session discussed the efficacy of teaching students strategic behaviors, such as cognitive monitoring, rehearsal, and self questioning. My attention was particularly drawn by one of the discussant's comments. Dr. Gagne' suggested that we consider an alternative to metacognitive training. This alternative is "building the strategies into the instructional materials rather than into the learners." Implicit in his response was the issue as to whether it is more efficient and effective to train students in metacognitive strategies or to include within instruction conventions and cues that preclude the need for strategy use.

This question interested me because it seems that instructional technologists opt for the approach of "building the strategies into the materials rather than into the learner quite often as we design, develop, and produce instructional materials. I do not think we have seriously investigated the pros and cons of operating under such a model. With the current willingness in our field to look inside the "black box" of cognitive processing (Bovy, 1981; Bruning, 1983; Winn, 1982) such an investigation appears to be timely.

In my discussion today, I am going to label the design alternative of "building the strategies into the materials" as a supplantation model for designing instruction (Ausburn & Ausburn, 1978). The model of "building the strategies into the learner" I will label as a generative model of design. These contrasting models of design represent the extremes of a continuum that illustrates the ratio of the amount of processing support provided by the instruction to the amount of cognitive elaboration required of the learner. There are advantages and disadvantages of each model and conditions under which each might be appropriate. Within this presentation I would like to do three things: a) describe the two models more completely, b) suggest a line of research investigating the conditions under which each model, or when compromises between the two models, might be appropriate, and c) relate all this to the philosophical questions that seem to be arising in our field.

In my discussion I will use examples from the design of instructional print. This is the medium which holds the greatest interest for me at the moment. However, I feel that the issues which we will examine extend beyond the qualities of any one medium.

Supplantation Model of Design

A supplantation model of design (Ausburn & Ausburn, 1978) "builds the strategies into the instructional materials rather than into the learner." An instructional designer operating under this model would seek to identify the information processing demands of a learning task and perform those transformations--to a greater or lesser extent--for the learners. When Ausburn and Ausburn spoke of the supplantation model of design, they added the condition that the supplantation in the instructional materials would perform only those information processing requirements for the learner that the learner is unable to supply for himself. I suspect

that instructional designers, in an attempt to make instruction as unambiguous and efficient as possible for the learner, may supplant some processing that the learner may actually be able to supply for himself.

The term supplantation seems to have come from Salomon (1979) who used it when describing the role of a zoom TV production technique. Students in his study were to complete a task which required attention to particular visual cues. Salomon conjectured that zooming in on relevant portions of a visual field would supplant the processing requirement of selecting pertinent cues from a field of many visual stimuli. He found, in fact, that this zooming did improve task performance for learners with low cue attendance skills; however, such supplantation depressed the performance of high cue attenders. Other studies investigating the effects of supplantation have found that supplantation techiques can aid haptic learners in tasks requiring comparisons of visual images (Ausburn, 1975) and field dependent learners in a task requiring the disembedding of a visual stimulus from a complex field of visual stimuli (Konkiel, 1981).

Allow me to give some specific examples of the supplantation model of design from the field of instructional print design. When designing instructional print, whether intentionally or by convention, we use a number of techniques to supplant some of the processing requirements of the "reading to learn" task. In a very fundamental sense, the task requirements of processing instructional text might be described as a) perceiving and decoding graphemic symbols, b) directing attention to important portions of the text (selective perception), c) organizing the concepts presented in the text in a form that can allow for encoding new information into existing cognitive structures, and d) retrieving and maintaining in working memory new information plus relevant information from existing cognitive structures.

These text processing requirements can be partially supplanted through

the use of text design conventions. For instance, in order to support the perception of graphic symbols, the text designer uses typography with the high visibility and layout that includes adequate leading and line length. Decoding is supported by the use of high frequency vocabulary (Glynn & Britton, 1984). The designer may direct the reader's attention to information that she considers to be pertinent to the learning task by including instructional objectives; by providing typographical cues such as bullets, boldface type, italics, or underlining; and by adding summaries, overviews, or prequestions. The text processing requirement involving development of an organizational scheme may be supplanted through the provision of headings, outlines, marginal notes, or formatting techniques such as information mapping (Horn,1976) or discourse punctuation (Showstack, 1982). Text designers may aid learners to encode new information into their existing cognitive structures (to integrate new information with prior knowledge) through the use of advance organizers, adjunct questions, and analogies (Glynn & Britton, 1984). The need to establish retrieval cues for future recall may be somewhat supplanted by the provision of access structures such as headings, marginal notes, and outlines. Finally, the demands of maintaining much information in working memory may be somewhat ameliorated through the use of chunking, lists, diagrams, charts, and verbal summaries.

As text designers we incorporate many of these processing surrogates in our materials. I suspect this will continue to be the case. However, there are sufficient equivocal research findings regarding the efficacy of such conventions (for example, Christensen & Stordahl, 1953; Hartley, 1980; Holley, 1980; Klare, Shuford & Nichols, 1958; Marshall & Glock, 1975; Meyer, 1975; Smith, 1983) for us to investigate the conditions under which such conventions promote learning and when they may actually have deleterious effects. One hypothesis to account for these equivocal results

is that, for some learners, in some learning tasks, and under some conditions, the provision of such embedded strategies may short-circuit (Salomon, 1979) the depth of processing required for the achievement of learning outcomes. Perhaps the inclusion of organization, emphasis, and retrieval cues not only fails to encourage the learner to make those elaborations (ties between prior and new learning) necessary for learning to occur, but also may actually inhibit the learner in doing these things. In the past few years, considerable attention has been given to the allegation that the supplantation of processing may actually be deleterious to learning (Bovy, 1981; Salomon, 1979; Wittrock, 1979).

Which brings us to an alternative model of design.

Generative Model of Learning

A contrasting design model can be derived from Wittrock's (1974) generative model of learning. The generative model predicts that the greatest learning will occur when students construct idiosycratic ties between the instructional stimulus and their current cognitive structures. A designer operating under this model might view as her responsibility the construction of instructional sequences that will stimulate (or allow) learners to generate their own idiosyncratic transformations of incoming information. Such instruction allows for active construction of meaning and is presumed to support the depth of processing needed for optimal learning.

There are at least two tactics available to the designer who is operating under the generative model. She may attempt to direct generation of cognitive elaborations (for example by suggesting that learners create their own summaries of an instructional passage), or she may simply refrain from supplying surrogates and allow for spontaneous use of a cognitive strategy that learners have already acquired(e.g., the

creation of their own summaries, outlines, or notes).

A text designer who is following a generative model of design may either direct or allow readers' text processing through a number of devices. A designer may direct generative decoding by including adjunct questions that require students to attach meaning to graphic symbols. The instructional text may suggest the use of generative attention-directing techniques such as underlining, circling, boxing, labeling, or drawing arrows. Or the text designer may simply allow students to spontaneously generate such cues for themselves. Students may be prompted to utilize such organization strategies as outlining; developing headings, labels, or keywords; making marginal notes; or creating webs, networks, or pattern notes (Fields, 1982). Encoding may be facilitated through such generative processes as answering application-level adjunct questions, creating analogies, writing summaries, or developing illustrations. Readers may establish their own retrieval cues with the attention-directing strategies such as underlining, boxing, and labeling. Finally, students may devlop their own strategies to accommodate the limitations of memory by generating mnemonics, diagrams, and setting up retrieval schemes.

Verbal learning studies suggest that stimulus materials that require generation of elaborations rather than supplanting such processing may lead to superior learning. Students appear to comprehend and remember better when they are required to generate their own underlining (Rickards & August, 1975); drawings (Bull & Wittrock, 1973), headings (Doctorow, Wittrock, & Marks, 1978), organizers (Wittrock, 1974), and questions (Frase & Schwartz, 1975) rather than having these processing supports provided for them.

Research literature includes, however, those studies that do not find a superior effect of learner-generated elaborations. A study by Dee-Lucas and DiVesta (1980) indicated that learners who generated topic sentences,

headings, or related sentences performed no better than, and in some cases not as well as, those learners who had these cues provided for them. Doctorow, Wittrock, and Marks (1978) found that a combination of text-supplied plus learner-generated elaborations were superior to either textual cues or learner elaborations alone in facilitating recall and comprehension.

Directions for Future Research

Of course it is not a question of which model--the supplantation or the generative--should be used by designers and developers. None of us would wish to design, much less attempt to learn from, instruction which contains no processing cues. At the same time, we have all heard students, particularly good students, grumbling about "predigested pap" or had the sense that something about our designs do not elicit maximum effort from our students. We need empirical data to help us identify the conditions which prescribe the balance between these two models.

The conditions that prescribe the selection of a design model go beyond the most commonly mentioned determining factor -- whether learners have the processing skills required of the task or not (Bovey, 1981). The conditions that define an optimal balance between the models may arise from the nature of the learner, the nature of the learning task, the nature of the instructional environment, and interactions of these variables. For example, investigations searching for this balance must go beyond examining learners' characteristics such as prior knowledge of content, available cognitive strategies, and general ability to such attributes as achievement motivation and personal learning objectives. For example, one can imagine instances when instruction designed under a supplantation model that provides the processing to aid learners to attain a specified goal, may be deleterious if a learner enters the instruction

with other learning goals in mind.

When considering the variable of task characteristics, while we must continue investigations into the information processing requirements of an instructional task (an overwhelming responsibility in and of itself!), it is critical that we extend the learning tasks that we examine beyond the verbal information objectives that are common in the research literature. Particularly if the instructional medium is print, we may profit from an examination of the implications of the limitations of cognitive capacity. For example, when a learning task requires the processing of instructional text in order to learn the application of an unfamiliar scientific principle, might it not be advantageous to supplant some of the text processing requirements in order to allow learners more mental "working space" for dealing with the complex principle? Other task features which require study are the ambiguity, complexity, and novelty of the learning task.

The constraints of the instructional environment must also be considered when determining the balance between the generative and supplantation models. For instance, when the designer anticipates that learners will be under debilitating time contraints, a tendency toward the supplantation model may be entirely appropriate.

While investigating the interplay of the learner, task, and learning environment determinents of the most appropriate balance between the two extremes in the design models, it is important that researchers utilize a number of dependent variables. We may profit from extending dependent variables to include measures of an efficiency/effectiveness ratio, levels of attention, fatigue or boredom reports, and long-term effects of both supplantation and generative models.

Conclusion

As the field of instructional technology matures, we seem to be moving

beyond the unquestionably effective techniques of the neo-behaviorists: the manipulation of the instructional stimulus to produce the desired, observable learning outcome. Many of us are investigating ways to refine this approach in order to accommodate potent factors that we have not considered in the past. One of these factors is the learner. In addition to the general aptitudes and prior knowledge of the learner, we wish to examine the design implications of the idiosyncratic processing strategies, cognitive organizations, and intentions of the learner. Being in the business of producing effective and efficient instruction we are also concerned with the pragmatic question of the extent to which we can afford to accommodate (even recognize) these idiosyncracies. In this presentation I have suggested one scheme within which we may begin to investigate these issues: a search for the conditions which specify the optimal balance between the supplantation and generative models of instructional design.

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